

H5 Is soil pore structure control on substrate decomposition manifested through N availability?

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Rationale and objectives: Soil pore structure determines the location of OM particles, the distribution of O₂, water, micro-organisms and the diffusion of nutrients. Mineral N availability plays a crucial role in microbial degradation of N-poor substrates. To study these complex relationships between microbial community, C mineralization and soil pore structure we set up an experiment with microcosm soil incubations combined with pore network quantification. We hypothesized that fungi would dominate C-mineralization in soils with a porous structure and low water content. Second, we hypothesized that C-mineralization would be stimulated by increased N diffusion in soils with a more compacted structure and higher water content. We expect this innovative combination of methodologies to reveal new insights in the small scale carbon dynamics and to a better understanding of the microbial community functioning.

Methodology approach: We created mini-soil cores with an artificially reconstructed soil texture, namely a silt and clay (S+C) content of 50% or an S+C content of 20%, and a sand content of 50 and 80%, respectively. The soil cores were subjected to different levels of water filled pore space (WFPS of 25% and 50%) and amended with either easily degradable OM high in nitrogen (grass) or more resistant OM low in nitrogen (sawdust). Combined with or without KNO₃ application, these soil pore structure-substrate treatments allow to create contrasting microbial communities. Microcosm incubations under controlled conditions were set up for 128 days during which CO₂ was measured frequently via GC-TCD. After 2 weeks, state-of-the-art X-ray CT was used to quantify the soil 3D architecture and the microbial community composition at the end of the incubation was assessed using PLFA fingerprinting. For the first time, CT-based characteristics of the local porosity surrounding the OM particles will be correlated with C-mineralization and microbial community structure.

Results and conclusions: C-mineralization in the sawdust treatments was higher in the 50%_S+C soils than in the 20%_S+C soils at 25%WFPS, while such effect was not observed at 50% WFPS or for grass at both water contents. This interactive effect of soil structure and substrate type suggests that soil structural control on C-mineralization would be induced by differences in N diffusion, causing differing N availability. PLFA, however, did not reveal promotion of fungal over bacterial biomarkers in treatments with likely N-limited substrate decomposition. Ongoing CT-based local porosity quantification could confirm existence of localized elevated porosity surrounding substrate particles.